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ABSTRACT

French postsecondary education for 16- to 19-year-olds is divided into programs that lead to the Baccalaureats--general, technical, and vocational--and to the lower-level Certificat d'Aptitude Professionnel (CAP) and Brevet d'Etudes Professionnelles (BEP). A common mathematics core curriculum is specified for all CAP students, regardless of specialty. More specialized mathematics is taught related to the student's vocational area. Individual teachers can and do restructure the curriculum to fit the abilities and prior achievement of the particular class and their vocational requirements. Research shows that French vocational students improve their mathematics in a system that demands high standards of students. In higher-level vocational courses (Vocational Baccalaureat), the mathematics objectives are more specialized, reflecting a definite choice of vocational area by the candidate. French vocational students have an incentive to work hard at the general education part of their courses because of the role these play in opening up future opportunities to them. By contrast, British courses of postcompulsory education increasingly conform to established practice at advanced level in not requiring the study of mathematics in postcompulsory education. This neglect of a core subject area hinders progression within the qualifications systems, depresses attainment, and lowers aspirations of both teachers and students. (Contains 57 endnotes.) (YLB)

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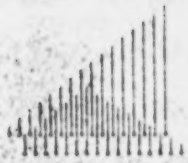

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MATHEMATICS FOR VOCATIONAL STUDENTS IN FRANCE AND ENGLAND: CONTRASTING PROVISION AND CONSEQUENCES

Alison Wolf

Discussion Paper no. 23

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MATHEMATICS FOR VOCATIONAL STUDENTS IN FRANCE AND ENGLAND: CONTRASTING PROVISION AND CONSEQUENCES

Alison Wolf*

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French vocational courses require all students to follow formal, compulsory mathematics courses for at least four hours a week. This requirement is fundamental to ensuring progression and transparency within post-compulsory vocational and general systems of education and to improving students' mathematical attainments as a result of vocational education and training. By contrast, British courses of post-compulsory education increasingly conform to established practice at Advanced Level in not requiring the study of mathematics in post-compulsory education. This neglect of a core subject area hinders progression within the qualifications systems, depresses attainment and lowers aspirations of both teachers and students.

Keywords Vocational training, mathematics

France

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Introduction

Educational debate in England and Wales has been characterised, since the 1980s, by a dual concern; with standards of basic education in the schools, and with participation rates in post-compulsory and higher education. Controversial government reforms in the school sector are intended to raise standards, notably in the core subjects of the National Curriculum. Post-16, there has been far more of a general consensus. English participation rates are considered too low; and, alongside a rapid increase in higher education enrolments, there has also been a drive to increase the numbers of young people and adults undergoing vocational training. This has been achieved partly through negative incentives - for example, withdrawal of benefits from unemployed 16 and 17 year olds - but also through the creation of a large-scale Youth Training programme, and new qualification structures which are expected to provide greater incentives to train.

The arguments for demanding good teaching of "the basics" to school children apply just as strongly to young people in vocational training. Mathematics, good written and spoken English, and, increasingly, a foreign language are a large part of what the job market demands. The importance of these highly generalisable skills is recognised in every survey of employers' requirements and hiring policies.[1] Moreover, rapid economic and technological change means that particular job requirements are likely to have a short life-span, and therefore that employers are increasingly interested in general skills. While craft and technician jobs and the older professions have high loadings of specific skills, in many white-collar jobs, general skills form a high proportion of immediate requirements too.

It is therefore important to evaluate how well vocational training programmes can consolidate and improve these key skills. This paper describes in detail the teaching of mathematics in French vocational education and compares it to practice in England and Wales. French policy is of particular interest because of the enormous emphasis currently placed there on upgrading levels of general education. It is also illuminating to compare France with England and Wales because the structure of the two systems is so markedly different. French experience therefore points up not only differences in outcomes, but also their origin in the structural characteristics of the education and training

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system.

This paper is based on discussions with teachers, education officials and researchers, and on direct observation of nine mathematics classes in five different establishments in the Dijon Academy (LEA) in 1990/1991. In addition, course regulations, syllabuses and and examination papers for recent years were compared in the two countries.

The paper is organised as follows: Part 1 outlines the structure of French post-secondary education, and recent developments in vocational awards. Part 2 deals with the mathematics curriculum, pedagogy and achievement in lower-level vocational awards in France: and section 3 provides a comparable overview of the higher level vocational baccalaureat. Section 4 discusses motivation and incentives in the French system. Section 5 analyses the English model of vocational training, and looks at mathematics teaching and learning in both BTEC courses and in National Vocational Qualifications (NVQs). A final section sets out the implications for English practice.

1. The structure of French post-secondary education

1.1 Design and control of recognised vocational and general qualifications

French education is organised in a number of hierarchical levels, each with its corresponding diplomas. While less so than in the past, it remains highly centralised, with courses uniform across the country in both subject matter and time commitments. The French Ministry of Education is responsible for the award of degrees, diplomas and certificates, the curriculum and the training and deployment of teachers. This, in turn, means that every course leads to a recognised qualification and is conceptualised from the start as part of a wider system, designed to provide occupational and academic coverage, and the possibility of progression from one certificate to the next. The mathematics component of a particular course is treated in the same way, in terms of progression to other diplomas and levels.

Course design is also informed by a universal belief in the value of "culture générale" or "general education" which underpins attitudes from senior ministry officials to craft teachers with a trade background, and

is also shared by employers responsible for apprentices or for providing the on-the-job elements in school-based vocational awards[2]. While this attitude has long-standing historical roots, it also reflects the view consistently promoted by the French government that, with continuing technological change and the breakdown of traditional forms of work organisation, the labour force needs high levels of general skills as much as or more than job-specific ones.[3]

In comparing French and English provision for 16-19 year olds, the relevant courses are, first, those which lead to the Baccalauréats - the general, the technical (technologique) and the vocational (professionnel); and second, the lower (craft) level CAP (Certificat d'Aptitude Professionnel) and BEP (Brevet d'Etudes Professionnelles). Students will generally begin one or other course at the end of compulsory schooling at around age 16, with, typically, a Baccalauréat course lasting three years, and a CAP or BEP course lasting two. Over 80% of all 16/17 year olds enrol on one of the above after the end of compulsory schooling.[4]

1.2 Progression within post-compulsory qualifications systems in France

The difference between studying for a craft qualification and entering directly onto a baccalaureat programme is a key one: - vocational qualifications do not, in general, enjoy high status in France. Nonetheless, these choices are not final or exclusive. After obtaining a CAP or BEP, it is possible to progress directly to a Baccalauréat, and complete it in two years.[5] The percentage of BEP students continuing their studies and entering baccalaureat programmes has risen from just over 5% in 1978 to 40% at present, with continuing increases predicted.[6]

Some of these students move back into the general or technical streams - they are a minority, but one which is expressly considered in setting the general education requirements for vocational courses. Increasing numbers of students progress to a "Baccalauréat Professionnel" (the Vocational Baccalaureat) which is the newest of the current awards.[7] This award is a central part of the current French strategy of increasing education levels and bringing 80% of the age cohort to "Baccalaureat Level".[8] Progression on to it from the BEP (or less often from the CAP) is expected and encouraged. Conversely, entry directly after the end of compulsory schooling is not an option.

Because each award constitutes a rung on a ladder of certification which is part of a nationwide system of recognised standards, course content is determined with regard to consistency over time and over the national territory. The characteristic shared by all of these awards is that each constitutes a complete programme of study, rather than (as in Britain) over-arching certificates which may consist of combinations of study options selected by the student. French students may choose, for example, between eight general Baccalauréat courses, sixteen Technological Baccalauréats, and no fewer than twenty nine Vocational Baccalauréats. However, within each course, all elements are compulsory, and there is no provision for further student choice.

All courses also have a compulsory general element. As noted above, "general education" is an unquestioned part of all French education and training for young people (including apprentices). All students study mathematics and French. Almost all study a modern foreign language. And all have programmes which include some or all of science, social studies, sport and the arts.[9]

1.3 Recent developments in the CAP and BEP awards.

The CAP and the BEP are best discussed together, because they are quite often awarded simultaneously to a given candidate. As compared to, for example, Germany or England and Wales, a very high proportion of young people in France studying for vocational awards do so in full-time vocational high schools (lycées professionnels). However, about a quarter of those enrolling for CAP courses (and a fifth of those obtaining the award)[10] are apprentices who study while employed under an apprenticeship contract.[11] All of these, it must be noted, are low-status options; most French parents and students prefer general academic education (General Baccalauréat) and the 'choice' of a vocational course is quite frequently a negative one - students tried for a general or technical course and were not accepted.

The CAP is a much older certificate than the BEP, vocationally specific in its practical content, and comprising several hundred different programmes, although many of these attract only a few entrants. From the early part of the century it was the traditional qualification of the French artisan class and then of industrial craftsmen; over the years the amount of practical training has decreased and the general education

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content has risen as a result of integration into post-secondary educational provision. Apprentices follow CAP courses; they attend Centres de Formation d'Apprentis (CFAs) for either one or two days a week, or on block release.[12]

The BEP, by contrast, was conceived as a vocational qualification for delivery only within the full time education system, and in the vocational high schools, entries are approximately 3/5 CAP, 2/5 BEP.[13] Each BEP corresponds to a cluster of CAPs (hence the potential for double entry), but the BEPs are not seen primarily as occupational training, but as educational courses with a strong vocational element. There are 47 BEPs, although only 20 attract sizeable numbers of entries.[14]

When the BEPs were first introduced many policy makers envisaged that the CAPs would wither away. The recent increased emphasis on bringing large numbers up to Baccalauréat level similarly led to a downgrading of the CAP within the vocational high schools. However, the CAP has signally failed to disappear. Smaller artisan employers and small firms prefer the CAP as a labour-market entry qualification because it is familiar and specific in focus - plastering, central heating installation, patisserie or charcuterie are all classic CAP-based occupations . In addition, it has proved unrealistic to expect all 16 and 17 year olds in full-time education to be capable of reaching the BEP standard. A qualification which makes fewer educational demands is still needed and the CAP is now being re-emphasised in full-time vocational schools.[15] However, for progression to the Vocational Baccalauréat, the BEP remains the principal route.

Vocational courses in France allow one to examine mathematics curriculum, and student incentives and motivation, in a context where these courses are integrated into a wider system of general and technical education, and which promotes progression both within and from the vocational track. The overriding concern of the French authorities has been the maintenance of the 'value' of state-recognised post-secondary qualifications in the labour market and in higher education. The mathematics curriculum reflects this concern: and, not coincidentally, displays major contrasts with current English practice.

2. Mathematics Curriculum and Pedagogy in Lower Level Vocational Awards in France (CAP, BEP)

2.1 The place of mathematics in the curriculum.

The CAP and BEP syllabuses are laid down by the Ministry of Education in consultation with employers, and are couched to a considerable degree in terms of outcomes and objectives. Syllabuses distinguish clearly between the practical/vocational and the general education parts of the course: which are, in turn, taught by different staff with different educational backgrounds and training and different conditions of service. The practical part of the course is not purely skills-based, but includes theoretical aspects of the occupational area. For example, in retailing, the vocational syllabus includes work on stock changes, inventory, and mark-ups, while in construction it covers the ability to read and interpret technical drawings and plans, estimate and calculate materials required, and understand the chemical composition of different mixes of concrete.

This means, in effect, that the vocational part of the course in itself requires a considerable amount of integrated mathematics. However, there is no reliance on this to provide, single-handedly, the level of mathematics required for the CAP and BEP. The separately delivered general education component includes a specified mathematics curriculum, which is also separately assessed. In this, France is by no means unusual. Germany, for example, also requires apprentices to pass a written maths test although content is vocationally focused.

CAP and BEP courses are organised around a 36 hour week, of which 14 hours are devoted to general education.[16] All students study mathematics and science for four hours a week, throughout their two year courses. In addition, some part of the 22 hours a week devoted to vocational and technical studies involved further mathematics exercises.[17]

A common mathematics core curriculum is specified for all CAP students regardless of specialism (with a rather more difficult one for BEP students.) This common syllabus covers around three quarters of the mathematics topics listed. In addition, more specialised mathematics is taught related to the student's vocational area.[18]

As the relative weighting of the common mathematics curriculum and the additional vocational specialities indicate, this is primarily a general mathematics syllabus. It is designed to provide a broad education, and to allow students to move across into other courses, as well as progress to higher vocational awards within their chosen speciality. The importance of "general education" is further accentuated by the assessment system, which examines and reports on the general education component separately from the vocational part.[19]

The curriculum is also, to English eyes, ambitious. In addition to standard arithmetic computations (including a heavy emphasis on percentages), the common core encompasses powers and roots, substituting into algebraic formulae, linear functions, solving equations (including solutions based on plots or graphs), and vectors.

The mathematics component of vocational courses is, as a rule, assessed through traditional written examinations. In the case of the CAP and BEP, the mathematics papers consistently combine, in varying degrees, abstract and applied questions. Thus a typical retail sector examination would include a number of "word problems" in a retail context involving arithmetic and percentage calculations (VAT, discounts, profit margins etc.); substitution into formulae and equations with one unknown; ratios; and descriptive statistics with a retail flavour involving histograms. Examinations for, say, plumbing consistently have a higher "pure maths" loading, with vectors, calculations with and plotting of functions; geometry; and a range of more applied problems involving energy requirements and costs, volumes, mass and pressure. Similarly, the applied problems in the construction examinations will involve quite complex volume calculations and those for electricians, naturally enough, problems involving current, resistance and transformations.

Although the syllabuses are largely equivalent, the examinations vary somewhat in difficulty as well as emphasis across occupational groupings. This would be commensurate with the acknowledged differences in the calibre of the students they attract. It is also reflected in the way the teachers deliver the syllabus: so that the mathematically very weak students whom we observed following a CAP retail course spent far more of their time on basic arithmetic than the plumbers and locksmiths observed in a general "construction sector" maths group.

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The high expectations of the French vocational mathematics curriculum are particularly remarkable given the target population. As noted above, staying on beyond the minimum school-leaving age is now virtually universal in France. The average school leaving age is now well over 18; and the percentage of the whole 16-25 year old age group in full-time education[20] has risen from 32.5% in 1983 to 43.4% in 1990.[21]

At the same time, there is a clear and well-defined hierarchy of awards, with the CAP and BEP far less valued than the classes leading to the general and (to a lesser degree) technical Baccalauréats.[22] The combination of this hierarchy with high staying-on rates means that vocational students are increasingly drawn from the lower parts of the achievement distribution.[23] Their English equivalents would be expected to have reached approximately level 5 or 6 on the National Curriculum by the time they reached the end of compulsory schooling, compared to level 10 for the most mathematically able, and 7 to 8 for middle ranking pupils.

2.2 The vocational mathematics curriculum in the classroom

The written and the delivered mathematics curriculum may, of course, differ widely, and in our visits to France we therefore looked carefully at teaching materials, classroom practice and examination papers.

It became clear that individual teachers can and do restructure the curriculum to fit the abilities and prior achievement of the particular class, and to tailor it more closely to their vocational requirements. This is also encouraged by the examination papers. As noted above, separate examinations are set for different occupational areas within the different vocational awards,[24] and questions are more restricted in coverage and vocationally-related than is suggested by the national syllabus. Nonetheless, the teachers did not simply teach to the test, or to the particular vocational context. The syllabus and objectives that teachers with whom we spoke set themselves for the year were a combination of particular foci with a commitment to covering the general syllabus. All of them saw their job as teaching general mathematics, not simply the requirements of a particular trade, and emphasised the importance of this for their pupils' future lives and prospects.

Because students entering CAP and BEP courses are likely to have experienced academic failure in the general compulsory school, the

mathematics teachers we talked to all adopted a common approach. They made no assumptions about prior understanding, but instead spent the first year of the course on a thorough review of "everything" (sic) that should have been understood earlier in the school - whole numbers, fractions, decimals, ratio/proportion, percentages, roots, powers, area and volume. As a result, a universal feature of the system is that lower-achieving young people receive an in-depth review and reinforcement of what can be called the "numeracy core".[25]

To recapitulate: young people in French vocational programmes receive, on average, four hours a week of maths and science, during which they will thoroughly revise the numeracy core. They follow a programme which is ambitious and forward-looking rather than derived from current job descriptions; and they study within a system whose requirements and standards are quite transparent, and which is designed explicitly to provide progression routes from all points and levels .

2.3 Improvement in mathematical attainments on lower level vocational courses in France

Thus far we have examined the degree to which the French system sets broad mathematical requirements for all courses, vocational or otherwise, and the high standards which these demand of students. What is far harder is to determine the degree to which these standards are achieved by students gaining the vocational awards. Data for France and England on students' attainments as a result of following vocational courses are virtually non-existent.

What is clear is that, during their two year vocational programmes, many French vocational students do improve their mathematics. We can infer this from data on those entering apprenticeship, who are especially likely to have had academic difficulties. Nationally, less than a quarter of apprentices have come from general academic classes, the rest having followed the alternative "technical" syllabus for the last two years of compulsory schooling, or attended one of the special classes for students with severe difficulties.

In some occupational areas, previous academic achievements are even lower. The records of one apprenticeship centre in Dijon show that over half of their retail apprentices in a recent year had come from Special Education

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rather than from any form of mainstream education: in other words, were students with identified learning difficulties. On entry, these retail students were all given a simple test of basic arithmetic at a level well below the final CAP mathematics examination for which they were expected to study, and involving questions on place value, simple number operations, and reading a timetable. On the usual French scoring out of 20, with 10 as a pass mark, the average score was just over 10.

56% of this group actually obtained their CAP in 1990. There was, not surprisingly, a strong correlation with previous educational success. Nonetheless, about 40% of those who had come from Special Education passed. And for the group as a whole, the average mark in the CAP maths examinations - which was considerably more demanding than the one they sat on entry, and involved questions on discounts, profit margins, ratios, and substitution into formulae - was 10.9 (out of 20). The data do not tell us how typical this is. Nonetheless, it is clear that progress in mathematics post-16 is possible with even the lowest attainers if structure and progression are provided and motivation is strong. This, in turn, points up contrasts with current English practice.

3. Mathematics curriculum and pedagogy in higher level vocational courses (Baccalauréat Professionnel) in France

3.1 Structure and development

The defining characteristics of the French system as outlined above are even more apparent at the next level up from the CAP or BEP. In France, the principal higher level vocational qualification is the Vocational Baccalauréat (baccalauréat professionnel): a relatively new diploma, which is promoted by the French government as part of its policy of educating 80% of an age cohort to Baccalauréat level.[26] Numbers obtaining the Vocational Baccalauréat increased from 1300 awards in the first year of its introduction in 1985-6 (less than half a percent of all Bacs), to 43000 in 1991.[27]

The Vocational Baccalauréat is as much an educational as a vocational award, reflecting again the French concern (some would say obsession) with general education. The syllabuses for each of the Vocational Baccalauréats were developed very carefully over a number of years by Ministry of Education task-forces working closely with representatives of the relevant

13 BEST COPY AVAILABLE

sectors.[28] Although holders of the Vocational Baccalauréat are eligible for entry to higher education, the award was seen by industry and the Ministry of Education as primarily qualifying candidates for direct entry to the labour market, and there are strong practical elements - a substantial amount of time is spent in the workplace (at least 16 weeks in a 2 year period), and one third of time in class is devoted to practical vocational skills.[29]

However, the needs of specific sectors were not the only consideration. These diplomas are intended to help raise the general skills of the workforce, as well as leading directly to particular sections of the labour market; and their content clearly reflects this. As with all other Baccalauréats, any candidate for the Vocational Baccalauréat must study and be examined in maths, science, French and a modern language. Those studying for the Vocational Baccalauréat based in full-time education[30] spend, over a two-year period, 52 weeks in college and 16 in the workplace; while those based in CFAs work on alternating two-week blocks of classroom and workplace. During the education-based part of a two year course, they will typically spend 30 hours a week in formal instruction, and another six on individual projects.

Each of the Vocational Baccalauréats is designed to follow on from related clusters of BEPs (much as the BEPs were based on clusters of CAPs). Compared to England, entry is thus very highly circumscribed. The regulations for the Construction baccalauréat are typical. They state that applicants holding any of 8 specified BEP and CAP diplomas should be given priority: and also that holders of 19 other such diplomas are eligible for admission, as are students who have completed specified amounts of specified technical Baccalauréat or Brevet de Technician programmes. Such restrictions obviously limit the degree to which young people can change their vocational track: but they are also a necessary prerequisite for clear progression routes and "transparent" awards.

3.2 The vocational mathematics curriculum in the classroom

Compared to the BEP and CAP syllabuses, the mathematics objectives for the Vocational Baccalauréat are actually more specialised, reflecting a definite choice of vocational area by the candidate. The general allocation of time, however, is fairly constant across awards, an average of 4 hours maths and science each a week.

In common with all other Baccalauréats, the vocational Baccalauréat is assessed through external final examinations set by the regional academies (LEAs). Mathematics is examined as part of integrated maths and science papers, characterised by a heavy emphasis on applications.

For example, a typical examination for the construction baccalaureat contains questions relating to a loggia with a domed roof (for which technical cross-sectional drawings are provided). Candidates must determine the equation which describes the curve of the roof; find different areas of the vault; and carry out calculations relating to the construction of a safe base platform and foundations for the load involved.

French students obtain (or fail to obtain) an overall qualification, rather than subject passes, whatever the level. The different parts of a course are all assessed, and a pass or fail ascribed to each: but their contribution to the final result is weighted, so that some are more important than others. The system used, as noted earlier, is one of "coefficients". For example one subject may carry a coefficient of 3, another a coefficient of 12: which means that the latter is four times as important to whether you pass overall. The coefficients for the Building (Batiment) baccalaureat, for example, total 22. The "scientific and technical" tests carry a total coefficient of 5 (i.e. almost a quarter of the total).[31] Within this, there is a formal maths and science paper (coefficient 3) and a written simulation (coefficient 2) requiring use of maths and science to analyse/cost/plan a piece of work.

The mathematical requirements of the Vocational Baccalauréat take the student well beyond the BEP. They are also more varied, reflecting the different demands of the different occupations, and more integrated and problem-oriented. In all cases, however, they involve topics which are found in the A level syllabus in England; and in all cases, the requirements are uniform and clear. Functions and trigonometry are particularly emphasised.

4. Pedagogy and motivation in vocational mathematics classes in France

It is always difficult to determine how far one set of observations provides the basis for sound generalisation to the country as a whole. We observed mathematics lessons of nine different vocational groups from the same geographical area of France which spanned a range of institutions and levels. These were not pre-selected, but comprised all those institutions teaching particular options within one area. However, a relatively small number of observations in an area recognised as having median attainments for the country as a whole can provide a reasonable degree of confidence in a highly uniform system such as France. Many of the teachers of the general education component of vocational education have taught in other schools (collèges and lycées) as well, and they are concerned to provide continuity between general and vocational schools.

The first point of note is the formal structure and presentation common to all the classrooms we visited. The teaching methods inculcated in teacher training (itself uniform throughout France) explain this. This formality of lesson structure is accompanied by considerable informality in teacher-pupil relationships. Formality of structure derives from the value placed by French education on setting things out in an orderly, logical and consistent fashion. Originality and intuition are not what the French mathematics classroom or the French examiner reward; if a student does not show a method properly, he/she will get no marks. Teaching is thus extremely systematic, emphasising correct and formal notation, and a set order of operations ("suivre la logique"). The typical pattern involves exposition by the teacher including a recapitulation of previous work by students, deskwork, and students working example solutions on the board.

Second, the planning of individual lessons is generally also systematic and excellent. Indeed, the degree to which French teachers plan and prepare their classes is one of the most impressive aspects of the system. The similarity of approach reflects the standards set in the training of these teachers, and the success of the French Ministry of Education in its openly professed aim of inculcating into teachers a national educational culture.

Teachers routinely prepare detailed lesson plans, and in many institutions teachers also complete a file which is attached to a given class and follows the class around from lesson to lesson, so that the different

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teachers know what their colleagues are doing, and so find it easier to coordinate and reinforce material.

The ability to plan in this way is, of course, in large part a function of a highly structured, clearly understood, and relatively stable curriculum. These teachers are not expected to rework their entire curriculum on a yearly basis, - and the relative stability and common elements across courses also make it worth publishers' while to produce textbooks and curriculum materials for the main vocational specialisms. The teacher unions also react immediately and actively to changes which they see as the imposition of unjustified increases in the workload. In principle, both the vocational and the general parts of the curriculum can be assessed through continuous assessment. This is increasingly the case for the vocational section. However, the teachers of general education, through their union, have resisted the move to continuous assessment, which they see as involving an enormous increase in work.

Third, there is (as in England) general agreement on the value of putting mathematics for vocational students in a vocational context, and relating it to applications - but enormous variation in the degree to which this is put into practice. We observed one Vocational Baccalauréat class where the teacher was using carefully prepared assignments related to industrial requirements, and where applications (in this case of trigonometry) were central to the whole presentation. In another class, at the same level, the teacher presented a mathematics lesson based on pages from a textbook. Similar contrasts were to be found at CAP/BEP level.

We argue at a number of points in this paper that the separate teaching of mathematics does not preclude the teaching (and learning) of applications. The French evidence supports this position. However, it also underlines the difficulty of creating uniformly good practice. In France, the major obstacle to contextualising mathematics is apparently not separate teaching or the syllabus requirements. Rather it is the lack of in-service help to teachers who might be teaching students from an unfamiliar occupational background, and the failure of the college or school to assist them in getting first-hand experience. Some went and obtained it for themselves, in their own time, others did not.

The fourth point of note is that students' motivation was uniformly high. While their degree of enjoyment and engagement varied greatly, in every

17 BEST COPY AVAILABLE

case those observed were working diligently at their mathematics sessions.

There is a number of reasons for this. Success is by no means assured; pass-rates of around two-thirds are typical for French diplomas. At the same time, success matters a great deal to the candidate. This is partly because France is generally very diploma-conscious; partly because of its high youth unemployment;[32] and partly because the coherence of the system makes different degrees of success into highly "tradeable" commodities. For example, many BEP and CAP holders do not want to enter the labour market straight away. They want to obtain entry into other courses leading to the Baccalauréat or to other higher level diplomas with greater market value: and that, in turn, is a competitive process.[33] Course selectors will look not only at whether an applicant has obtained their qualification, but also at their detailed dossier, where general education marks will figure large.[34]

To reiterate: French vocational students have an incentive to work hard at the general education part of their courses because of the role these play in opening up future opportunities for them. Without such incentives, the best teaching in the world will not achieve much in the way of student learning. Equally, effective incentives require a well structured system, in which requirements and achievements are clearly understood by all concerned. The following section compares the English with the French system, and asks how far English practice currently provides such incentives.

5. The implications of the English model of vocational training for mathematics teaching and learning

5.1 The structure of English vocational training

English vocational training is currently in a period of transition, with the final structure of qualifications and delivery systems only partly determined. New-style awards accredited by the National Council for Vocational Qualifications (NCVQ) are covering an increasing proportion of specific vocational training, and will, from 1992-3, be piloted in full-time post-compulsory education. However, the largest growth in demand, in recent years, has been for the longer-established awards run by BTEC (Business and Technician Education Council).

Until the advent of NCVQ, post-compulsory provision in England had a roughly tripartite structure. Academic A levels carried the highest prestige, and were the main route into higher education - as, indeed, they still are. A large number of highly specific vocational awards also existed: offered in the traditional craft areas by City and Guilds; in secretarial and related areas by the Royal Society of Arts; and in myriad individual areas by specific occupational bodies (such as the Institute of Bankers). Some large areas were effectively without any qualification structure. Thirdly, BTEC offered a range of courses suitable for school-leavers, followed through full-time or part-time study in Further Education colleges.[35] National Diploma courses are two-year courses from which progression to higher education is increasingly common. While some (e.g. engineering) are quite vocationally specific, others are very much a vocationally-oriented form of general education - more general than, for example, the vocational Baccalauréats. Academically weak students frequently took (and take) a one-year fulltime BTEC First Diploma straight after compulsory schooling: either as a precursor to a National Diploma course, or as a final qualification before leaving education.[36]

Compared to France, this was a system notably lacking in either a clear structure or routes for progression. Most of the non-A level awards were unfamiliar to higher education selectors or to employers outside a particular, highly defined area: so that they offered little in the way of "general currency" to their holders. There was no clear way of equating awards in terms of levels, and little faith in the consistency of standards used. The NVQ reforms were intended to redress this situation.

The system also differed from the French in that there was no attempt at national level to ensure that all awards provided substantive elements of general education, allowing students the possibility of switching back to an academic programme or to another vocational track. In this, it must be emphasised, the vocational sector reflected the dominant academic one. The English system[37] is remarkable in its rejection of an integrated programme of general education post-16, and the way that it allows its able, as well as its less able, students to drop foreign languages, mathematics and/or most uses of the English language. Decisions at age 16 thus pre-empt most later choices. While the concern of this paper is with vocational rather than academic training, it must be emphasised that the lack of coherent thought for progression in one reflects the same absence in the other. The following two sections look separately at mathematics teaching in BTEC

courses in further education; and within the emerging NVQ system. This reflects the current situation, in which the old craft qualifications have, for the most part, been reworked in line with NVQ requirements: while, at the same time, a very large proportion of fulltime FE students on vocational courses are working for BTEC awards.

5.2 Mathematics in full-time further education: the BTEC vocational curriculum

For non-academic full-time students in post-compulsory education, the BTEC National and BTEC First Diplomas are key qualifications.[38] The BTEC First is a one-year course, which, as noted above, is often taken by students whose academic record is too weak for them to be accepted for a National Diploma (or on to a good craft course). Many, however, progress from a First to a National programme. A National Diploma is obtained after a 2 year full-time course which is akin to the French in being conceived as a part of general education rather than simply training and many of those obtaining it go on to higher education, at sub-degree and degree level.[39] Entry onto a Diploma course direct from school is supposed to require a number of good grades at GCSE but recent recruitment patterns have been producing student groups whose academic backgrounds are far more diverse than notional entry requirements would imply.[40]

The basic procedures and teaching approach are the same for both First and National Diplomas: and the discussion which follows (drawing largely on National level) can therefore be generalised across both awards. "Centres" (usually FE colleges) which are approved to offer a particular Diploma do so within general guidelines and requirements laid down by BTEC. However, they are individually responsible for devising the course, including developing all learning materials; for assessing it (subject to moderation); and for approving the award.

In some cases, there may be a compulsory mathematics unit (or more) notably in the case of engineering and science-based awards. Other courses have no obligation to offer separate maths teaching. On the contrary, integration of mathematics into the context and objectives of the course is encouraged. All courses do, in principle, have to incorporate "common skills" which include "applying numeracy".[41] However, these have no specific standards or assessment requirements attached to them. Not surprisingly, therefore, the course teams responsible for developing and

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delivering a given course pay them little attention except when writing reports to BTEC to "demonstrate" that the common skills have been covered.

The absence of separate mathematics requirements (and active discouragement of separate mathematics lessons) is related to BTEC's belief that maths should be related to the contexts in which it is used. It is absolutely true that students who are taught abstract maths in isolation have enormous difficulty in applying and using mathematics, and that people can combine apparently quite high levels of mathematics skills with a complete inability to solve basic workplace problems which involve the application of "basic" numeracy. However, as we noted in discussing the French vocational Baccalauréat, there is no reason why encouraging mathematics applications and vocationally relevant techniques need preclude separate mathematics teaching.

The BTEC approach results, instead, in a lack of clear guidance to students and teachers on what is expected; and a lack of standardisation in what is delivered. French teachers can obtain guidance on standards and content coverage from published assessment material: indeed, books with previous years' papers (and worked solutions) form a major part of French bookshops' stock in trade. In addition, because course syllabi are specific and stable, and because a regard for progression means that they contain many common elements, it is worth publishers' while to produce high quality textbooks and materials for the vocational market.

By contrast, not only is there no single common examination paper or assessment for a BTEC qualification, there is also no exemplar material available to students or teachers. Most of the materials used in BTEC courses are developed from scratch by individual teachers or college-based teams, more or less hastily and with negligible resources. Colleges will vary enormously in the degree to which the materials they produce and the assignments they set include substantial amounts of mathematics. In many of the most popular courses[42] it is common for there to be no mathematics specialists at all in the course team delivering the award: and enormous leeway in the degree to which any new mathematical concepts or operations are introduced.[43] If English vocational students had reached a uniformly high standard of basic mathematics at the start of their programmes, this might not matter: but in fact, every relevant study confirms that, as a group, they have serious weakness in mathematics.[44]

Inevitably, this lack of standardisation is reflected in the highly variable attainments of those gaining an award. This in turn means that students coming into higher education by the BTEC route may find themselves ill-prepared. A recent study[45] demonstrated that vocational path entries into degrees with a maths component display enormously varied standards of maths, and consequent high failure rates. To reiterate: compared with French vocational courses, full time students in England receive highly variable amounts of mathematics teaching, within a framework which does little to ensure standardisation of attainment, or encourage staff to set new or ambitious targets for their students' mathematics learning.

5.3 The NVQ model

The problems with the BTEC approach to mathematics learning are not just the fault of that institution. They reflect a national failure to develop a properly structured system of qualifications and progression routes, albeit compounded by pedagogy which precludes transparency and guarantees variability in standards. The establishment of the National Council for Vocational Qualifications, and the development of a system of NVQs, was intended to create just such a general structure of awards for the first time in English vocational education, and also to ensure that the content and standards of each such award were extremely clear. Up to now, the bulk of effort has been devoted to vocational qualifications which require a major element of workplace training and experience - NVQs proper.

Unfortunately, in mathematics, the reforms which were designed to improve and update vocational training, have actually tended to exacerbate the problems of the English system. A companion study to this one has examined mathematics in construction courses in England, France and Germany and concluded that the NVQs which have replaced the older craft courses have reduced rather than strengthened mathematics teaching and learning.[46] This paper argues that such a result follows ineluctably from the current NVQ model.

The reason is that the procedures developed militate against long-term planning or the inclusion of general education in vocational programmes. Under the aegis of the Department of Employment, a network of "lead industry bodies" has been established, with responsibility for drawing up

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standards which encapsulate the level and content of "occupational competence" in the industry concerned. Vocational awards based on these standards - and only such awards - may be accredited as "National Vocational Qualifications" at levels 1, 2, 3, 4 and 5.

This system will, eventually, provide a hierarchical structure into which all vocational awards fit. Unfortunately, however, employers have not been asked, when drawing up standards, what they look for in hiring young people, or what they want from their workforce in the future, but, instead, what is actually required for competence in particular occupations now, today. This snapshot is then used not as one (important) input into programme planning - as it would be in, say, France or Germany - but as the determinant of new syllabi and qualifications. NVQs are based entirely on industry-led standards, with no institutional role for other contributions.

Because standards are drawn up for particular occupations and industries in isolation, there is no mechanism here for considering progression routes. It is not the job of a lead industry body to consider whether the vocational programme implied by a set of standards will enable someone to move onto another track - whether this be an academic programme, a technical or vocational one in another sector, or even another occupation in the same vocational field. On the contrary: standards of competence must only contain material directly related to the immediate or foreseeable requirements of the occupation in question.[47]

For an adult worker, who has made a firm vocational commitment, and who is seeking formal accreditation of skills, none of this may matter. For a young person it matters very much indeed. This is ironic: because the NVQ system was intended to prevent people's progress being impeded by academic drift and unnecessary educational requirements. Instead it is actually tending to create a new set of major barriers to progression.

The problem is further compounded by the particular way in which standards are specified, and NVQs delivered and assessed. The formal definition of occupational competence provided by NCVQ is very broad, and could, in principle, be stretched to justify introducing quite general skills. However, the format required of standards (and, therefore of NVQs) involves detailed specification of outcomes defined in behavioural terms.[48]

In practice, and especially among the lower level vocational awards (levels 1 and 2), this has tended to produce long lists of very narrowly defined practical competencies. Since everything covered by an NVQ must be assessed, getting through these practical activities is naturally a trainer's or lecturer's first priority. NCVQ has always set itself firmly against the creation of separately assessed modules ("units" or "elements") dealing with the general skills and knowledge which underlie competent performance. Thus, there is no separate specification of the mathematics involved in an occupation: the lecturer or trainer is expected to infer it from the "performance criteria" which specify the final outcome of occupational competence, and encouraged to deliver it as an integral (or incidental?) part of the vocational training proper. While the absence of separate modules does not actually debar trainers from setting time aside to teach mathematics and other subjects separately, it certainly gives them little incentive to do so in a crowded timetable.

5.4 The consequences of the NVQ model for mathematics in the vocational curriculum

Evidence of how NVQs are currently being delivered confirms that the NVQ model provides little incentive for mathematics teaching. We surveyed 17 colleges offering vocational qualifications in five different areas[49] and found that many college staff teaching towards awards at NVQ level 2 or 3 have (to date) continued to try to make time for calculations. Full-time students may receive an hour a week of numeracy or craft calculations (though many do not); but part-time students in the colleges and occupations surveyed received no separate mathematics instruction at all. No lecturer reported an increase in mathematics teaching time over the last few years: and those teaching construction courses reported a decline.[50]

We have no evidence on whether trainees in industry-based schemes receive separate mathematics tuition: but the pressures of time and costs to which such schemes are subject makes it unlikely that they will do so to a greater degree than those in FE colleges.

Under current arrangements, all the incentives are for staff to further reduce the amount of mathematics they provide. There are no overt assessment requirements for mathematics: there are multiple such

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requirements for practical skills. Publishers are not involved in providing materials for mathematics in NVQ courses: any such materials must be produced by staff themselves. Finally, current funding arrangements tie payments directly to candidates' success rates.[51] In this situation, it is very hard to justify spending time on areas which are not definitively required for an award. An institution which receives more money for trainees or students who receive an NVQ than for those who fail, has little incentive to allocate time to what is "optional".

This type of training is also not one in which standardisation of mathematics provision can possibly be achieved. Many colleges told us that the amount of external moderation they received had declined in recent years: another factor which is likely to reduce consistency of coverage and standards. Finally, it is worth emphasising that students currently have little incentive to work hard at their mathematics. If something is not formally assessed, and not directly required for your award, why should you give it much of your attention?

A number of the college lecturers interviewed also expressed the concern raised earlier in this paper: that the new award risks actually reducing the extent to which award holders are equipped to progress to higher levels within their own occupational field or to transfer to other occupational areas. One of the strengths of English craft education in the past has been the opportunity for able people to rise through the industry: with construction a notable example. Current NVQ level 2 specifications imply such a restricted amount of mathematics that young people now obtaining these qualifications are unlikely to have the mathematical foundations to progress to higher level awards.

5.5 The introduction of GNVQs

NVQs are avowedly specific in design: qualifications designed to attest to "occupational competence", to appeal to adults as well as young people, and to require a substantial amount of workplace experience. Their introduction was therefore only a first step to creating an overall structure for the post-compulsory sector. Many young people are not interested in making final choices at the age of 16 - hence the growing popularity of BTEC awards - and remain in full-time rather than work-based education and training. "General National Vocational Qualifications" (gNVQs) are intended to cover this sector, and provide a clear hierarchy

of levels and guarantee of comparable standards.

The first gNVQs will be introduced in September 1992, and it is therefore impossible, at the time of writing, to know how exactly they will be delivered. Like NVQs, they are written in terms of units (modules) and highly specified outcomes to be achieved (using "performance criteria"). They also all contain "core skill units" in application of number, communication, and information technology, on which all students will be assessed.

The core skills requirements are expressed, following NVQ practice, in terms of the usual outcome statements. However, it is extremely doubtful whether these requirements will actually give lecturers an incentive to deliver separate and well structured mathematics lessons, and even more questionable whether these specifications can deliver the standardised and transparent levels of achievement which NCVQ claims for them.

Core skill units are not actually separate parts of a course at all. There is no obligation to provide separate maths or English teaching on which to base the assessment: on the contrary. Students are to be assessed on their level of core skills as displayed across the whole of their programme: that is, on the basis of skills which they display more or less incidentally in the course of other activities. But in any course, and particularly one based largely on projects and assignments, as gNVQs will be, the mathematics (and other general skills) used will vary enormously from student to student. Moreover, we know from a considerable number of research studies that it is effectively impossible for people to "extract" particular skills from different activities and reach consistent judgements about their level of difficulty.[52]

The problem is exacerbated by the type of objectives set for the core skills. "Application of number" is intended to cover five levels, each one subdivided into

"Gather and process data"

"Represent and tackle problems"

"Interpret and present mathematical data"

Outcome statements are provided which are intended to explain exactly what should be achieved: for example, under "represent and tackle problems", we find "activities required by the techniques are performed to levels of precision and in the correct sequence". Levels are differentiated simply

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by the "range" of mathematical techniques to be used - e.g. "estimating probabilities of combined events" or "using Pythagoras' theorem".

These criteria can supposedly be used by lecturers to infer, in a reliable way, what level a student has achieved: and to inform the world of precisely what that assessment consists. But, even if the mathematics were delivered separately, it is hard to see how courses based purely upon such statements could prove either consistent in their content and standard, or transparent to students, employers, or other educational institutions. As a way of "extracting" mathematical achievement from other activities, it is doubtful whether the criteria can be used in any meaningful fashion.

Overall, it seems unlikely that gNVQs will, in their present form, improve the quality of mathematics learning in English vocational programmes. Instead, NCVQ has embraced an extreme form of the "integrationist" philosophy which has dominated BTEC and NVQ provision to date, and whose drawbacks have been outlined in the previous sections.

6. The case for transparency and coherence in English qualifications systems with special reference to mathematics

In England and Wales, specific maths requirements in vocational courses are unusual, and indeed increasingly rare. Moreover, it is quite common for individual lecturers, and FE college course teams, to respond to students' difficulties by recommending that the mathematics elements of a course be cut to a minimum - and adjusting their own teaching accordingly. The temptation to do this is reinforced by the fact that, for given courses, English classes tend to be much more heterogeneous.[53] They often include both students with very low levels of prior mathematics attainment and students from a much higher part of the achievement distribution than the equivalent French group. This is a result of the smaller "academic" A Level stream in Britain and the much higher proportion (of mostly low attainers) entering the labour market at the end of compulsory education.

However, studies of English vocational students' skills invariably show that, as a group, they have serious mathematics problems. The response of cutting down on the mathematics taught risks creating a self-perpetuating cycle of low expectations and low-level performance: and, more broadly, restricting the potential for progression of all students in a group. The lack of ambition manifested in English vocational course design contrasts

dramatically with the situation in France, where we never heard teachers recommend or express a desire to reduce the mathematics coverage of the vocational syllabus. Nor is this a possibility which course designers there entertain. On the contrary: the objectives are set high with an express view of increasing national performance levels and ensuring that students are challenged and guaranteed the possibility of progression.[54]

This difference in ambition is mirrored in the difference in resources devoted to mathematics in the two countries. English students working towards NVQs may, at most, receive a hour or so a week on craft calculations. BTEC students will receive separate mathematics in some areas: otherwise, only what can be covered as part of their other lessons. By contrast, French students in both lower and higher level vocational courses will receive 4 hours a week of maths and science teaching throughout their two year course.

This reflects an enormous difference between the two countries in the way they allocate resources: but not, it must be emphasised, only with respect to mathematics. One reason why the French can and do dedicate so much more time to mathematics than the English is that they provide many more hours in class. French students studying for a CAP, BEP or vocational baccalaureat can expect to spend 35 or 36 hours a week in formal education. The norm for English students in full-time college courses is about 20 hours - only just over half as much.[55]

England and France also differ dramatically in the relative transparency of their mathematics requirements. In France, everyone involved in the system knows what is being covered and assessed: and that, across the country, different papers will reflect a common curriculum, and common understanding of the different emphases of different sectors. Published papers and published learning materials - as is possible in a stable system - reinforce and maintain this transparency. As previous comparative analyses have emphasised,[56] such clear information flows are an important precondition for effective vocational education and training systems.

In England neither the older nor the newer awards achieve this transparency with respect to mathematics. At present, examining bodies such as BTEC fail to set out clear standards of attainment expected of their awards, even for the use of teachers. Not only is there no single common centralised examination paper or assessment for a BTEC

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qualification, there is also no exemplar material. NVQs and gNVQs are intended to provide extremely specific "standards" for teachers, learners and assessors. But the mathematics required has to be inferred and extracted from descriptions of outcomes ("performance criteria") which are concerned entirely with eventual workplace behaviour (in the case of NVQs) or with some more general applied task (in the case of gNVQs).

The problem with the dominant English approach is that it ignores a fundamental principle of school and college dynamics, that if something is not the main concern of a lesson, it will quickly cease to be a concern at all. It also, we would argue, embodies a basic confusion between the value of placing maths in context, and the value of explicit mathematics teaching. To argue that maths will make more sense within vocational courses if it is placed in a vocational context does not commit one to abolishing separate maths teaching, yet it seems generally to be assumed that it does.

The commitment to "embeddedness" means that the qualifications are opaque rather than transparent - one has to interrogate individual qualifications very carefully in order to understand what their creators thought was appropriate mathematics content. The combined lack of transparency and local implementation leaves room for large differences in the standard accepted for an award. Moreover, if vocational qualifications provide no clear thresholds for entry or success which can be understood by the labour market and HE as a whole, then one has also reduced students' incentives to learn.

In France, qualifications and curricula are developed as part of a system in a way that English ones are not. This relates partly to the structure of awards: as we emphasised earlier in this paper, French qualifications are designed explicitly in terms of progression possibilities and requirements. However, it also relates to the fact that the curriculum is conceptualised at national level, with common objectives for general education which are applied throughout the education and training system.

England and Wales (and, indeed, Scotland)[57] have no such coherent objectives for general education, any more than they have a system which plans and provides for systematic progression routes. As so often, mathematics provision encapsulates these general features. In England, among the academic group who pass at least one A level, less than a fifth

of the girls and a bare third of the boys who study in school have included mathematics in their A level programme. A system which legitimises such neglect of mathematics among its elite school groups is unlikely to generate vocational awards which address mathematical requirements adequately. Nor does it.

Conclusion

The teaching of mathematics in French vocational programmes is neither perfect - nor available as a direct transplant. What this comparative analysis nonetheless makes clear is that current French practice is more successful than that of England and Wales in consolidating previously taught skills; in the firm foundation provided for progression and in the degree to which teachers, students, examiners and employers understand what is expected, and delivered. It is also clear that, during their period in vocational programmes, students - many from very low achieving groups - do make progress. There are lessons here for this country, especially given that our current failures are not merely likely to affect skill levels, productivity and prosperity at some macro level, but demonstrably damage individuals' capacity to progress in their careers.

Endnotes

1 See, for example, the report of the CBI's Vocational Education and Training Task Force, Towards a skills revolution - a youth charter (London: CBI, 1989); Labor Market Information Network (1979) Employers' Views on Hiring and Training (New York:LMIN); General Accounting Office (1982) Labour Market Problems of Teenagers Result Largely from Doing Poorly in School (Washington: US General Accounting Office); Reading University studies

2 Similar observations are to be found in, for example, S. Prais and H. Steedman, Vocational Training in France and Britain: the building trades, National Institute Review, May 1986.

3 This belief is supported by a range of studies which emphasise the importance to employers of mathematics and communication skills. In the specific case of mathematics, new technology has created new requirements rather than reducing the demands for mathematical competence. See, for example, Labor Market Information Network (1979) Employers' Views on Hiring and Training (New York:LMIN); General Accounting Office (1982) Labour Market Problems of Teenagers Result Largely from Doing Poorly in School (Washington: US General Accounting Office); Tony Fitzgerald (1982) Applications of Mathematics for Pupils of Low Attainment *Teaching Mathematics and its Applications* 1.1 5 - 10; University of Bath (1981) Mathematics in Employment (16-18) (University of Bath); A. Wolf, M. Kelson and R. Silver Learning in Context R & D Report no. 43 (Sheffield: Dept. of Employment)

4 Currently, about 14% leave directly after the end of compulsory schooling: DEP Bulletin 02/91.

5 i.e. Four years in total (2+2) compared to three for those proceeding to a baccalaureat programme.

6 Note d'Information 92 - 12. As with other parts of the French education system, these staying-on rates have risen rapidly in recent years. Comparable figures for a panel study of pupils who were in the 6e (beginning of secondary school) in 1980 show rather over a third of BEP students continuing to further studies.

7 Note d'Information 92-12. The percentage of BEP "leavers" entering 1ère (i.e. the technical or general bac. classes) rose to 15% in 1985, when the vocational bac. was introduced, and the stabilised, with the further increase all taken up by vocational bac. entries.

8 For a full discussion of this strategy and its consequences for the qualification structure see Marie-Thérèse Rapiau & Hilary Steedman "The improvement in workforce qualifications in France: consequences for poorly-qualified school-leavers" NIESR discussion paper, forthcoming.

9 For example, the vocational baccalaureat in construction includes technology, mathematics, physical sciences, business studies, French, a modern foreign language, arts, and sport.

10 *Repères et Références Statistiques 1990*, Table 12.2. (Ministère de l'education Nationale de la jeunesse et des sports).

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11 In 1988-9, there were 229,000 apprentices, making up 24% of enrolments for "second-cycle" (secondary level) vocational awards. This was a higher percentage than in the mid-'70s, but lower than in the '50s and '60s. This figure subsumes major inter-regional variations, however. Of the 24 administrative regions used for apprenticeship/employment purposes, 2 had less than 14% of their 2nd cycle vocational students following apprenticeships, and 9 had more than 29% so enrolled. There are also large variations between courses in the importance of apprenticeship.

12 The CFAs have just received approval to offer BEP courses as well.

13 *Repères et Rèférences Statistiques 1990*, Table 12.2. (Ministère de l'education Nationale de la jeunesse et des sports).

14 The BEPs are more occupationally specific than is envisaged for the gNVQs to be piloted in English schools from 1992. See below, section 5 for a full discussion of developing English qualifications.

15 Tanguy, L. 'Quelle formation pour les ouvriers et les employés en France?' p.126, La Documentation Française 1991

16 including sport

17

	Hours per week			
	Year One		Year Two	
Written French/'life skills'	3		3	
Family and social economics	1		1	
Foreign languages	2		2	
Maths and science	4	(2+2)	4	(2+2)
Sport	4		4	
Vocational and technological studies (including 3 hours technical drawing)	22		22	
	36		36	

18

	Common core	Geometry	Trigonometry	Tertiary sector maths
Construction	¼	¼		
Mechanical	¼	¼	¼	
Electrical/chemical	¼	¼	¼	
Tertiary: food	¼			¼
Services	¼			¼

19 In each case, different parts of the course are examined or assessed separately (with each having a pass mark of 10/20). However, they are not equally important. Instead, they have weights - "coefficients" - which determine their contribution to the final result. The higher the coefficient, the greater the contribution it makes to the overall result, and to passing or failing. The construction CAPs and BEPs are typical in this respect. Both are divided into vocational and general sections: with the coefficients for the vocational part summing to 16, and those for the general education section totalling 6 for the CAP and 9 for the BEP. A pass requires an overall score of 10/20 on the merged and weighted totals for both domains plus a score of 10/20 or more in the vocational domain: in other words, you cannot pass overall without passing the practical section. For the vocational score, 1/4 of the marks are for the theoretical technology part of the syllabus, and the rest for the practical: while within the general domain, maths (or maths/science) would typically contribute a third of the weight - in the BEP case, a coefficient of 3.

20 including apprenticeship

21 Ministry of Education bulletin: DEP 35/91

22 As the percentage of young people obtaining baccalauréats increases, parents are increasingly unwilling to have their children enter the lycées professionnels to take a BEP or CAP - even though they may later continue to a bac. pro. Apprenticeship enjoys very low status in France, although, especially in the traditional craft areas, one will find a number of able and motivated students.

23 For example, in Burgundy, in 1990, 63% of pupils continued directly onto a general or technical baccalauréat course at the end of 3ème and 28% began a vocational course. The composition of each group was extremely closely related to academic performance. SAIO/ONISEP Bourgogne Dossier du Professeur edition 1991

24 This is true at all levels. See below for a discussion of the Vocational Baccalauréate

25 A good proportion of students in vocational courses will have entered them not from the (theoretically unstreamed) general classes, but from "preparatory apprenticeship classes" (in the case of apprentices), "technological" stream 4e and 3e classes (which offer a more practical curriculum and more limited general syllabus than the mainstream 4e and 3e), or special "CPPN" classes for students with particular academic difficulties. All of these are marked by concentration on basic maths.

26 It is important to distinguish between educating 80% to this level - which is the commitment - and having 80% obtain an award. The French generally accept relatively high failure rates as appropriate. In 1989 there was a 73% success rate for the bac. pro., 69% for the technical baccalaureat and 76% for the general baccalaureat

27 Note d'information 91.39. At present the Vocational Baccalauréat has 29 different options: some available in large numbers of different establishments, some in only a few scattered across the country, some now well established, some offered for the first time in 1992. It already enrols higher numbers than the older and more specific Brevet de Technicien, which can be completed in 3 years at the lycée if one enters direct from the general stream, or in two years after a BEP. Over the last twenty years, entries for the BT have run at roughly 3% of the entries for the CAP + BEP: in 1989, there were only 7,432 awarded (11,141 entries: a 67% pass rate).By contrast, ever increasing numbers of BEP holders go forward into the far less specific bac. professionnel. One important reason for the greater success of the Vocational Baccalauréat is that it confers the right to enter higher education.

28 For a discussion of this process see Hilary Steedman Vocational Training in France and Britain: Mechanical and Electrical Craftsmen, NIESR Discussion Paper 130 Jan. 1988 (pp 15-17) and Judith Watson The French Baccalauréat professionnel, Post-16 Centre Working Paper No. 9 Institute of Education, University of London

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29 Indeed, one result of the growing general education elements in the CAP is that, as several vocational teachers observed, to find practical skills at the level of the old CAP one must now look for a bac. pro. graduate. There is, of course, an inherent tension between the ever-increasing emphasis by the Education Ministry on general education and the demand for high levels of practical and specific skills from some parts of the labour market.

30 It is also possible to do a "sandwich" bac. pro. in certain areas - e.g. construction - through the Centres de Formation d'Apprentis. These work on alternating 2 week blocks of work experience and classroom study.

31 1990 regulations (Brochure F6416: Baccalauréat Professionel Batiment: Étude de Prix, Organisation et Gestion de Travaux)

32 In explaining levels of French participation, structural unemployment is very important. Young workers are very expensive, and so, especially at times of recession, employers are reluctant to take them on, preferring older employees. This, in turn, is a major factor in explaining the current huge increase in staying-on rates in France, and the development of a "certification spiral". See M-T Rapiau & H Steedman, op cit: OECD Economic Surveys :France 1991/2 (Paris: OECD 1992)

33 The number of places on a course is decided well in advance, and will not be expanded suddenly in response to a surge of applicants.

34 This is especially important in the case of the CAP & BEP where one can pass overall without having passed the general education section.

35 English courses can be, and often are, taken by older student returners as well.

36 For a fuller discussion of provision see Alison Wolf (1992) England and Wales: An assessment-driven system. Research Working Paper no. 2, International Centre for Research on Assessment, Institute of Education, University of London

37 And, to a lesser degree, that of Scotland.

38 There is also a Diploma in Vocational Education, offered by City and Guilds. This replaced the Certificate in Pre-vocational Education (CPVE), run jointly by City and Guilds and BTEC.

39 The most common progression is to a two-year Higher National Diploma: but a National Diploma may be, and quite often is, accepted as an entry qualification for other higher education awards.

40 As part of an investigation of the mathematics attainment of students starting vocational courses in France and England, data were collected on examination results of first-year vocational students. Most of the English sample were following craft courses (for NVQs): but in some colleges, we also obtained background information for students on BTEC retail courses. These confirmed what we had been told anecdotally: namely, that a good number of students on National courses do not meet the recommended prior standards for English and maths, and good GCSE grades overall.

41 The full list is: 'Managing and Developing Self'; 'Working with and relating to others'; 'Communicating'; 'Managing Tasks and Solving Problems'; 'Applying Numeracy'; 'Applying Technology'; and 'Applying Design and Creativity'.

42 e.g. Business and Finance; Leisure

43 The situation may be illustrated by the example of the most popular single Diploma: Business and Finance. The first year involves 8 modules: 3 core and 5 options, for all of which only general objectives and content are laid down. The Core modules include The Organisation in its Environment (some economics); and Finance. These might seem, ostensibly, to demand some mathematics: in practice, they can involve none. Whether the economics involves even basic supply and demand curves will depend on who is teaching it: if the class seems mathematically weak, the lecturer may decide to skip anything "too demanding". And even if it is taught, it may well never be examined: since the typical assessment tool is a fairly open-ended type of assignment. The same is true for Finance: students will be taught some personal finance and to read the financial pages of a newspaper. But as for more mathematical topics, such as gearing - and the use of ratio is fundamental to financial analysis - as one head of department remarked, "There's so much to cover, and no time to schedule any maths separately, even when they desperately need it. You can't test everything - and the moderator is only going to worry about whether we've followed the right processes in developing and assessing the course." As for the options - one can choose business statistics and accounting. One can just as easily not, and avoid any maths there at all.

44 See, for example, Marie-Thérèse Rapiau & Alison Wolf Apprenticeship in England & France: mathematics attainment, patterns of recruitment and their socio-economic implications. Paper presented to the 1992 CESE conference, Dijon France; Alison Wolf, Marcia Kelson & Ruth Silver Learning in Context (Employment Department R & D series no. 43); Sig Prais and Karin Wagner, Schooling Standards in Britain and Germany: some summary comparisons bearing on economic performance, National Institute Review May 1985. For a comprehensive picture of mathematics attainment levels among English students towards the close of compulsory schooling, see the surveys of the Assessment of Performance Unit (HMSO)

45 Alan Smithers (1991) The Vocational Route into Higher Education (School of Education, University of Manchester)

46 H. Steedman (1992) Mathematics in Vocational Youth Training for the Building Trades in Britain, France and Germany National Institute Discussion Paper no. 9.

47 Elements of competence must "relate to what actually happens at work" (NVQ criterion 2.3.1)

48 Thus "performance criteria... must contain evaluative statements which define the acceptable level of performance in employment, normally in terms of its outcome" (criterion 2.4). Performance "must be demonstrated and assessed under conditions as close as possible to those under which it would normally be practised". (4.3.4)

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49 Construction, retail, hairdressing, motor mechanics and catering. We wanted to include trainees in industry-based schemes, but were unable to find any which could make trainees available to take a short (40 minute) mathematics exercise: and therefore had to confine ourselves to colleges actively involved in NVQ delivery and provision of off-the-job training for YT schemes. See A. Wolf & M-T Raplau (1992) op cit.

50 Only one of the courses surveyed provided as much as 2 hours of numeracy to full-time students.

51 The Department of Employment's latest Annual report states that "25% of (Youth Training) resources for 1992/3 will be paid on condition that trainees achieve a National Vocational Qualification or its equivalent." In practice, rates vary somewhat between TECs and according to circumstances. The money is paid to managing agents, who may then, if trainees are attending college, pay college fees "up front". However, even if a college receives its full fees - and it is the managing agent who loses funds for trainees who do not complete their NVQ - a college with a low success rate is likely to find that the managing agent takes business elsewhere the following year.

52 See, for example, A. Pollitt, C. Hutchinson, N. Entwistle & C de Luca (1985) What makes Exam Questions Difficult? (Edinburgh: Scottish Academic Press); A. Wolf Assessing Core Skills: wisdom or wild goose chase? (1991) Cambridge J. of Education 21.2

53 See A Wolf and M-T Raplau (1992) op cit

54 In the last few years, some targets have undoubtedly been set too high, as part of the push towards the "80% to bacc. level". New science requirements for CAPs, for example, are generally seen by both employers and teachers as excessive for their target population. See H. Steedman (1992) op cit.

55 Norms vary from college to college and course to course: but calls to a number of leas in the South east which do collect figures produced answers ranging from 18 to 22 hours a week for "contact time".

56 e.g. E. Keep (1991) The grass looked greener in P. Ryan (ed) International Comparisons of Vocational education and Training for Intermediate Skills (Lewes:Falmer); C. Hayes et al (1984) Competence and Competition (London: NEDO/MSC)

57 Although Highers enable students to take a larger number of subjects than A levels, they are still able to select from only a limited range of subjects: and many Highers candidates in fact take only one or two exams. As for the National Certificate (the modular vocational courses offered in schools and colleges), in 1989, only 25% of full-time further education students taking National Certificate modules were taking one (or more) in maths and statistics: and for those in YT, the figure was only 16% Moreover, these figures conceal huge male/female differences. 40% of fulltime male FE students have taken a maths module - 17% of females. In YT the figures are 26% and 2%. Highest maths take-up is among full-time apprentices and workers on day release, where 38% have taken a maths module. Those doing so are overwhelmingly in engineering or construction programmes. See Linda Croxford, Cathy Howieson and David Raffe Young People's Experience of National Certificate Modules: Final Report. (1991) Centre for Educational Sociology, University of Edinburgh.